

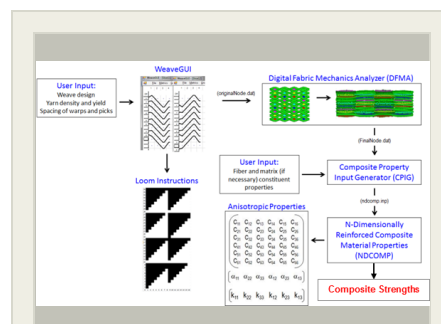
Calculation of Effective Material Strengths for 3D Woven Hybrid Preforms and Composites, Phase II

Completed Technology Project (2014 - 2017)



Project Introduction

The design concepts being considered for Heatshield for Extreme Entry Environment Technology (HEEET) rely on the use of 3D woven carbon fiber preforms. Therefore, there is a need to be able to predict the properties and performance of a woven material. Validation of predictive modeling tools would allow for the use of these tools to design and optimize the 3D weaves, significantly reducing the cost of fabrication and testing of a variety of configurations. While there are proven tools for the prediction of laminate composite properties, textile composites are relatively new materials and much less effort has been focused on modeling this class of materials. Therefore, MR&D is proposing to use the lessons learned from the Phase I effort, to improve the strength prediction capabilities, evaluate the effects of porosity and molding of curved panels, and deliver a beta version of a 3D weave design optimization tool. A combined analytical and experimental program has been proposed. The analytical effort involves modifying the current version of the 3D weave modeling tool, based on the lessons learned in the Phase I program, to include things such as unique bundle strengths for the different yarn types and improved failure criteria to improve the strength prediction capabilities. It also includes increasing the current capabilities to allow for estimating properties of 3D woven composites with varying levels of porosity or that have been molded into curved panels. The experimental effort involves fabrication and testing of various 3D woven reinforced composites (flat, curved, partially densified). The properties obtained from this experimental effort will enable improved calibration of the modeling tools. Finally, the final portion of the Phase II effort will focus on the preparation of a beta version of the 3D weave design optimization tool for delivery to NASA for use in heat shield design as well as other applications requiring the use of 3D woven preforms.



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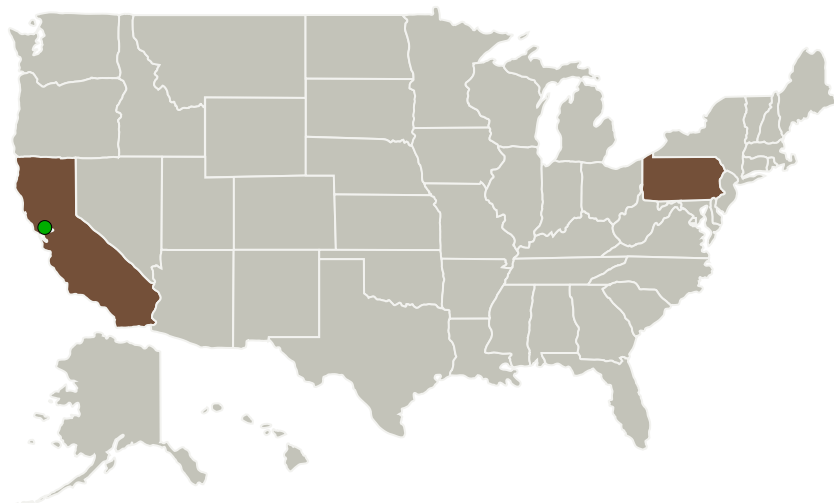
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Materials Research and Design, Inc.	Lead Organization	Industry	Wayne, Pennsylvania
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Pennsylvania

Project Transitions

April 2014: Project Start

January 2017: Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/137626>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Materials Research and Design, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

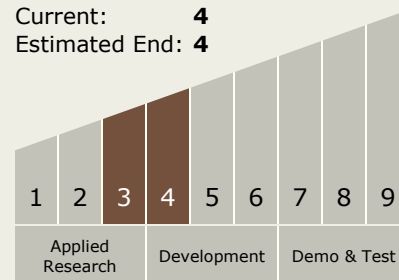
Kerry D Hopp

Technology Maturity (TRL)

Start: **3**

Current: **4**

Estimated End: **4**

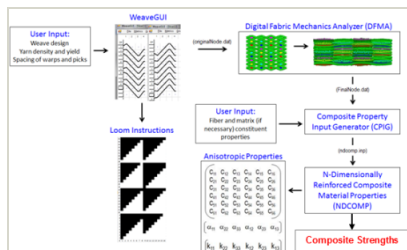


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Images



Briefing Chart Image

Calculation of Effective Material Strengths for 3D Woven Hybrid Preforms and Composites, Phase II
(<https://techport.nasa.gov/image/131125>)



Final Summary Chart Image

Calculation of Effective Material Strengths for 3D Woven Hybrid Preforms and Composites, Phase II
Project Image

(<https://techport.nasa.gov/image/126703>)

Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
 - └ TX09.1 Aeroassist and Atmospheric Entry
 - └ TX09.1.1 Thermal Protection Systems

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System